



**Entergy Nuclear Operations, Inc.**  
Pilgrim Nuclear Power Station  
600 Rocky Hill Road  
Plymouth, MA 02360

**Stephen J. Bethay**  
Director, Nuclear Assessment

April 21, 2007

U.S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, DC 20555-0001

**SUBJECT:** Entergy Nuclear Operations, Inc.  
Pilgrim Nuclear Power Station  
Docket No. 50-293  
License No. DPR-35

Weld Filler and Welding Electrode Materials for Structural Weld Overlays  
Within the Scope of Pilgrim Relief Request, PRR-15

**REFERENCE:**

1. NRC Approval of Pilgrim Relief Request No. PRR-15, Rev. 1, Approval to Include Remaining Reactor Pressure Vessel (RPV) Safe-End Welds in Contingency Repair Plan for Full Structural Weld Overlays (TAC. No. MD2663), dated April 2, 2007
2. EPRI Report No.1007921, Revision 1 of No.1006804, "Qualification of Welding Alloy 52M for Alloy 600/690 Repairs"

**LETTER NUMBER:** 2.07.040

Dear Sir or Madam:

This letter provides information related to the weld filler and welding electrode materials, which will be used to perform reactor pressure vessel safe-end weld repairs within the scope of Pilgrim relief request referenced above (Reference 1).

Entergy plans to use Inconel 52M/152M materials instead of Inconel 52/152 filler materials for weld repairs discussed in Reference 1. Inconel 52M/152M series are refined versions of Inconel 52/152 filler material.

Attachment 1 provides the specifications of alloy 52M/152M materials. The 52M/152M materials have been added into ASME Section II, Part C and ASME Section IX by the 2004 Edition/2006 Addenda. The use of these materials does not invalidate NRC evaluation presented in Reference 1.

A047

Like Alloy 52/152, welds made using Alloy 52M/152M are fully austenitic nickel alloys whose alloy and weld deposits do not depend on the formation of delta ferrite for sound quality. This is due to the high nickel (Ni) composition (approximately 60% Ni and low iron (Fe) content). An added advantage of Alloy 52M/152M is that, unlike Alloy 52/152, it is not susceptible to microfissuring and ductility dip cracking. Alloy 52M has been formulated to address ductility dip cracking. This is responsible for Alloy 52M/152M having less oxides and floaters present to affect Non Destructive Examination (NDE) personnel. In addition, Alloy 52M/152M's high level of chromium (Cr) like alloy 52/152 provides significant resistance to IGSCC. EPRI has done extensive research (Reference 2) with Inconel 52M/152M. It is superior for weldability and NDE in comparison to Inconel 52/152 while still maintaining the significant resistance to IGSCC.

The application of these weld materials provide an acceptable level of quality and safety.

There are no commitments contained in this letter.

If you have any questions or require additional information, please contact Mr. Bryan Ford, Licensing Manager, at (508) 830-8403.

Sincerely,



Stephen J. Bethay

Attachment 1: ASME Section IX, 2006 Addenda, July 1, 2006 (8 pages)

cc: Mr. James Kim, Project Manager  
Office of Nuclear Reactor Regulation  
Mail Stop: 0-8B-1  
U.S. Nuclear Regulatory Commission  
1 White Flint North  
11555 Rockville Pike  
Rockville, MD 20852

U.S. Nuclear Regulatory Commission  
Region 1  
475 Allendale Road  
King of Prussia, PA 19406

Senior Resident Inspector  
Pilgrim Nuclear Power Station

ATTACHMENT 1  
(To Entergy letter No. 2.07.040)

ASME Section IX, 2006 Addenda, July 1, 2006

(8 pages)

**ASME BOILER AND PRESSURE VESSEL CODE  
AN INTERNATIONAL CODE**

**QUALIFICATION  
STANDARD FOR  
WELDING AND  
BRAZING PROCEDURES,  
WELDERS, BRAZERS,  
AND WELDING AND  
BRAZING OPERATORS**

**THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS  
NEW YORK, NEW YORK**



**B090W6**

**IX**

**2006 Addenda  
July 1, 2006**

**ASME BOILER AND  
PRESSURE VESSEL  
COMMITTEE  
SUBCOMMITTEE ON  
WELDING**

# SPECIFICATION FOR NICKEL AND NICKEL-ALLOY BARE WELDING ELECTRODES AND RODS

A06



SFA-5.14



(Identical with AWS Specification A5.14/A5.14M:2005.)

## 1. Scope

**1.1** This specification prescribes requirements for the classification of bare nickel and nickel-alloy welding electrodes, strip electrodes, and welding rods. It includes those compositions where the nickel content exceeds that of any other element.

**1.2** Safety and health issues and concerns are beyond the scope of this standard and, therefore, are not fully addressed herein. Some safety and health information can be found in the nonmandatory annex, Sections A5 and A10. Safety and health information is available from other sources, including, but not limited to, ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*.

**1.3** This specification makes use of both U.S. Customary Units and the International System of Units (SI). The measurements are of exact equivalents; therefore, each system must be used independently of the other without combining in any way when referring to material properties. The specification with the designation A5.14 uses U.S. Customary Units. The specification A5.14M uses SI Units. The latter are shown within brackets [ ] or in appropriate columns in tables and figures. Standard dimensions based on either system may be used for sizing of filler metal or packaging or both under A5.14 or A5.14M specifications.

## PART A — GENERAL REQUIREMENTS

### 2. Normative References

**2.1** The following standards contain provisions which, through reference in this text, constitute provisions of this AWS standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreement based on

this AWS standard are encouraged to investigate the possibility of applying the most recent editions of the documents shown below. For undated references, the latest edition of the standard referred to applies.

**2.2** The following AWS standards<sup>1</sup> are referenced in the mandatory sections of this document:

- (a) ANSI/AWS A1.1, *Metric Practice Guide for the Welding Industry*
- (b) ANSI/AWS A5.01, *Filler Metal Procurement Guidelines*

**2.3** The following ANSI standard<sup>2</sup> is referenced in the mandatory sections of this document:

- (a) ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*

**2.4** The following ASTM standards<sup>3</sup> are referenced in the mandatory sections of this document:

- (a) ASTM E 29, *Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications*
- (b) ASTM E 76, *Standard Methods for Chemical Analysis of Nickel-Copper Alloys*
- (c) ASTM DS-56H/SAE HS-1086, *Metals & Alloys in the Unified Numbering System*
- (d) ASTM E 354, *Test Methods for Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys*

<sup>1</sup> AWS standards can be obtained from Global Engineering Documents, an Information Handling Services (IHS) Group company, 15 Inverness Way East, Englewood, CO 80112-5776.

<sup>2</sup> This ANSI standard can be obtained from Global Engineering Documents, an Information Handling Services (IHS) Group company, 15 Inverness Way East, Englewood, CO 80112-5776.

<sup>3</sup> ASTM standards can be obtained from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

## WELDING DATA

QW-432

A06

## F-NUMBERS (CONT'D)

## Grouping of Electrodes and Welding Rods for Qualification

F-No.	ASME Specification	AWS Classification	UNS No.
Copper and Copper Alloys (CONT'D)			
36	SFA-5.7	ERCuAl-A2	C61800
36	SFA-5.7	ERCuAl-A3	C62400
37	SFA-5.6	ECuMnNiAl	C60633
37	SFA-5.6	ECuNiAl	C60632
37	SFA-5.7	ERCuMnNiAl	C63380
37	SFA-5.7	ERCuNiAl	C63280
Nickel and Nickel Alloys			
41	SFA-5.11	ENi-1	W82141
41	SFA-5.14	ERNi-1	N02061
41	SFA-5.30	IN61	N02061
42	SFA-5.11	ENiCu-7	W84190
42	SFA-5.14	ERNiCu-7	N04060
42	SFA-5.14	ERNiCu-8	N05504
42	SFA-5.30	IN60	N04060
43	SFA-5.11	ENiCr-4	W86172
43	SFA-5.11	ENiCrCoMo-1	W86117
43	SFA-5.11	ENiCrFe-1	W86132
43	SFA-5.11	ENiCrFe-2	W86133
43	SFA-5.11	ENiCrFe-3	W86182
43	SFA-5.11	ENiCrFe-4	W86134
43	SFA-5.11	ENiCrFe-7	W86152
43	SFA-5.11	ENiCrFe-9	W86094
43	SFA-5.11	ENiCrFe-10	W86095
43	SFA-5.11	ENiCrFe-12	W86025
43	SFA-5.11	ENiCrMo-2	W86002
43	SFA-5.11	ENiCrMo-3	W86112
43	SFA-5.11	ENiCrMo-4	W80276
43	SFA-5.11	ENiCrMo-5	W80002
43	SFA-5.11	ENiCrMo-6	W86620
43	SFA-5.11	ENiCrMo-7	W86455
43	SFA-5.11	ENiCrMo-10	W86022
43	SFA-5.11	ENiCrMo-12	W86032
43	SFA-5.11	ENiCrMo-13	W86059
43	SFA-5.11	ENiCrMo-14	W86026
43	SFA-5.11	ENiCrMo-17	W86200
43	SFA-5.11	ENiCrMo-18	W86650
43	SFA-5.11	ENiCrMo-19	W86058
43	SFA-5.11	ENiCrWMo-1	W86231
43	SFA-5.14	ERNiCr-3	N06082
43	SFA-5.14	ERNiCr-4	N06072
43	SFA-5.14	ERNiCr-6	N06076
43	SFA-5.14	ERNiCrCoMo-1	N06617
43	SFA-5.14	ERNiCrFe-5	N06062
43	SFA-5.14	ERNiCrFe-6	N07092
43	SFA-5.14	ERNiCrFe-7	N06052
43	SFA-5.14	ERNiCrFe-7A	N06054
43	SFA-5.14	ERNiCrFe-8	N07069
43	SFA-5.14	ERNiCrFe-11	N06601
43	SFA-5.14	ERNiCrFe-12	N06025
43	SFA-5.14	ERNiCrFeAl-1	N06693
43	SFA-5.14	ERNiCrMo-2	N06002
43	SFA-5.14	ERNiCrMo-3	N06625
43	SFA-5.14	ERNiCrMo-4	N10276
43	SFA-5.14	ERNiCrMo-7	N06455

**TABLE 1**  
**CHEMICAL COMPOSITION REQUIREMENTS FOR NICKEL AND NICKEL-ALLOY ELECTRODES & RODS**

Weight percent <sup>a,b</sup>																		
AWS Classification <sup>m</sup>	UNS Number <sup>c</sup>	C	Mn	Fe	P	S	Si	Cu	Ni <sup>d</sup>	Co	Al	Ti	Cr	Nb (Cb) plus Ta	Mo	V	W	Other Elements, Total
ERNi-1 <sup>k</sup>	N02061	0.15	1.0	1.0	0.03	0.015	0.75	0.25	93.0 min	—	1.5	2.0 to 3.5	—	—	—	—	—	0.50
ERNiCu-7 <sup>k</sup>	N04060	0.15	4.0	2.5	0.02	0.015	1.25	Rem	62.0 to 69.0	—	1.25	1.5 to 3.0	—	—	—	—	—	0.50
ERNiCu-8 <sup>k</sup>	N05504	0.25	1.5	2.0	0.03	0.015	1.00	Rem	63.0 to 70.0	—	2.0 to 4.0	0.25 to 1.00	—	—	—	—	—	0.50
ERNiCr-3 <sup>k,l</sup>	N06082	0.10	2.5 to 3.5	3.0	0.03	0.015	0.50	0.50	67.0 min	e	—	0.75	18.0 to 22.0	2.0 to 3.0 <sup>f</sup>	—	—	—	0.50
ERNiCr-4	N06072	0.01 to 0.10	0.20	0.50	0.02	0.015	0.20	0.50	Rem	—	—	0.3 to 1.0	42.0 to 46.0	—	—	—	—	0.50
ERNiCr-6 <sup>k</sup>	N06076	0.08 to 0.15	1.00	2.00	0.03	0.015	0.30	0.50	75.0 min.	—	0.40	0.15 to 0.50	19.0 to 21.0	—	—	—	—	0.50
ERNiCrFe-5 <sup>k</sup>	N06062	0.08	1.0	6.0 to 10.0	0.03	0.015	0.35	0.50	70.0 min	e	—	—	14.0 to 17.0	1.5 to 3.0 <sup>f</sup>	—	—	—	0.50
ERNiCrFe-6 <sup>k</sup>	N07092	0.08	2.0 to 2.7	8.0	0.03	0.015	0.35	0.50	67.0 min	—	—	2.5 to 3.5	14.0 to 17.0	—	—	—	—	0.50
ERNiCrFe-7 <sup>j</sup>	N06052	0.04	1.0	7.0 to 11.0	0.02	0.015	0.50	0.30	Rem	—	1.10	1.0	28.0 to 31.5	0.10	0.50	—	—	0.50
ERNiCrFe-7A <sup>i,p</sup>	N06054	0.04	1.0	7.0 to 11.0	0.02	0.015	0.50	0.30	Rem	0.12	1.10	1.0	28.0 to 31.5	0.5 to 1.0	0.50	—	—	0.50
ERNiCrFe-8 <sup>k</sup>	N07069	0.08	1.0	5.0 to 9.0	0.03	0.015	0.50	0.50	70.0 min.	—	0.4 to 1.0	2.00 to 2.75	14.0 to 17.0	0.70 to 1.20	—	—	—	0.50
ERNiCrFe-11	N06601	0.10	1.0	Rem	0.03	0.015	0.50	1.0	58.0 to 63.0	—	1.0 to 1.7	—	21.0 to 25.0	—	—	—	—	0.50
ERNiCrFe-12	N06025	0.15 to 0.25	0.50	8.0 to 11.0	0.020	0.010	0.5	0.1	Rem	1.0	1.8 to 2.4	0.10 to 0.20	24.0 to 26.0	—	—	—	—	0.50

## INCONEL<sup>®</sup> Filler Metal 52M

**INCONEL Filler Metal 52M** is used for the gas-tungsten-arc and gas-metal-arc welding of INCONEL alloy 690, and the overlaying of carbon steels and stainless steels to provide a nickel-chromium alloy corrosion resistant surface. The high chromium level provides excellent resistance to stress corrosion cracking in the nuclear, pure water environment. The product can also be used in applications requiring resistance to oxidizing acids. It is useful for dissimilar joints involving INCONEL and INCOLOY alloys.

This product contains Boron and Zirconium to minimize the tendency for ductility-dip cracking, while it is especially resistant to oxide "floaters" and inclusions.

### Specifications

AWS A5.14 ERNiCrFe-7A (UNS N06054)  
Proposed to ASME II, Part C, SFA-5.14, ERNiCrFe-7A  
Proposed to ASME IX, F-No.43

### Approvals

Please confirm details of current scope of approvals with the Technical Department prior to order placement.

### Limiting Chemical Composition (%)

Ni .....	Remainder	Ti .....	1.0 max.
C .....	0.04 max.	Co .....	0.12 max.
Mn .....	1.0 max.	Nb .....	0.50 to 1.0
Fe .....	7.0 to 11.0	P .....	0.02 max.
S .....	0.015 max.	Zr .....	0.02 max.
Si .....	0.50 max.	B .....	0.005 max.
Cu .....	0.30 max.	Mo .....	0.50 max.
Cr .....	28.0 to 31.5	Others .....	0.50 max.
Al .....	1.10 max.		

### Minimum Mechanical Properties

Tensile Strength, psi	80,000
MPa	552
Elongation, (4d) %	30

Filler metals available on spool and in cut straight lengths in a variety of sizes selected from the following diameters:

### Available Product Forms

mm	0.8	0.9	1.0	1.14	1.2	1.6	2.4	3.2
in	0.030	0.035	0.040	0.045	0.047	0.062	0.093	0.125

Straight Lengths - 915 mm (36 in.) or 1000 mm (39 in.)

**INCONEL<sup>®</sup> Filler Metal 52M**



## INCONEL® Welding Electrode 152M

**INCONEL Welding Electrode 152M** is used for the shielded-metal-arc welding of INCONEL alloy 690, and the overlaying of carbon steels and stainless steels to provide a nickel-chromium alloy corrosion resistant surface. The high chromium level provides excellent resistance to stress corrosion cracking in the nuclear, pure water environment. The product can also be used in applications requiring resistance to oxidizing acids. It is useful for dissimilar joints involving INCONEL and INCOLOY alloys. This product contains Boron and Zirconium to minimize the tendency for ductility-dip cracking.

### Specifications

AWS A5.11 ENiCrFe-7 (UNS W86152)

Other specifications to follow.

### Approvals

Please confirm details of current scope of approvals with the Technical Department prior to order placement.

### Limiting Chemical Composition

Ni .....	Remainder
C .....	0.05 max.
Mn .....	5.0 max.
Fe .....	7.0 to 12.0
S .....	0.015 max.
Si .....	0.75 max.
Cu .....	0.50 max.
Cr .....	28.0 to 31.5

Co .....	0.12 max.
Nb .....	2.5 to 1.0
P .....	0.03 max.
Zr .....	0.02 max.
B .....	0.005 max.
Mo .....	0.50 max.
Others .....	0.50 max.

### Minimum Mechanical Properties

Tensile Strength, psi	80,000
MPa	552
Elongation, (4d) %	30

**Available Product Forms** — Supplied in 10lbs (4.54kg) hermetically sealed containers

Diameter	mm in	2.4 3/32	3.2 1/8	4.0 5/32	4.8 3/16
Length	mm in	229 9	356 14	356 14	356 14
Current (DC+)	A	45-70	75-110	95-140	125-165

INCONEL® Welding Electrode 152M

## INCONEL® Filler Metal 52

**INCONEL Filler Metal 52** is used for gas-tungsten-arc and gas-metal welding of INCONEL alloy 690. This NiCrFe welding product was developed to meet the changing needs of the nuclear industry, the higher chromium level providing greater resistance to stress-corrosion cracking in the nuclear, pure water environment. INCONEL Filler Metal 52 produces corrosion-resistant overlays on most low-alloy and stainless steels. It can also be used in applications requiring resistance to oxidizing acids. It is useful for dissimilar joints involving INCONEL and INCOLOY alloys, and carbon, low-alloy and stainless steels and for overlaying on to steel.

### Specifications

AWS A5.14 ERNiCrFe-7 (UNS N06052)

ASME II, Part C, SFA-5.14, ERNiCrFe-7 (UNS N06052)

ASME IX, F-No.43

\*(EN) ISO 18274 - SNi6052 (NiCr30Fe9)

\*Supply to these specifications available upon request

For manufacture to ASME III (NCA3800, NB2400), and other specifications please refer your inquiry to the Technical Department prior to order placement.

### Approvals

Please confirm details of current scope of approvals with the Technical Department prior to order placement.

### Limiting Chemical Composition

Ni+Co .....	Remainder	Cr .....	28.0-31.5
C .....	0.04 max.	Ti .....	1.0 max.
Mn .....	1.0 max.	Al .....	1.10 max.
Fe .....	7.0-11.0	P .....	0.02 max.
S .....	0.015 max.	Nb+Ta .....	0.10 max.
Si .....	0.50 max.	Al+Ti .....	1.5 max.
Mo .....	0.50 max.	Others .....	0.50 max.
Cu .....	0.30 max.		

### Minimum Mechanical Properties

Tensile Strength, psi	80,000
MPa	552
Elongation, (4d) %	30

Filler metals available on spool and in cut straight lengths in a variety of sizes selected from the following diameters:

### Available Product Forms

mm in	0.8	0.9	1.0	1.14	1.2	1.6	2.4	3.2
	0.030	0.035	0.040	0.045	0.047	0.062	0.093	0.125

Straight Lengths - 915 mm (36 in.) or 1000 mm (39 in.)

# Ni-Cr-Fe Welding Electrode

www.specialmetalswelding.com



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## INCONEL® Welding Electrode 152

**INCONEL Welding Electrode 152** is used for shielded-metal-arc welding of INCONEL alloy 690. It has a higher chromium content which improves resistance to stress-corrosion cracking in the nuclear, pure water environment. It was designed to produce high quality welds in all positions. This electrode also produces corrosion-resistant overlays on most low-alloy and stainless steels. Other uses include applications requiring INCONEL alloy 690 "glass melters" used for the disposal of nuclear waste. It is also useful for dissimilar joints involving INCONEL and INCOLOY alloys, and stainless, low-alloy and carbon steels.

The electrodes provide excellent operability for groove and fillet welding in the downhand position and the smaller diameter electrodes are also suitable for all position welding. Power supply: direct current, electrode positive.

### Specifications

AWS A5.11 ENiCrFe-7 (UNS W86152)

ASME II C SFA-5.11, ENiCrFe-7 (UNS W86152)

ASME IX, F-No.43

\*(EN) ISO 14172 - ENi6152 (NiCr30Fe9Nb)

\*Supply to these specifications available upon request

For manufacture to ASME III (NCA3800, NB2400), and other specifications please refer your inquiry to the Technical Department prior to order placement.

### Approvals

Please confirm details of current scope of approvals with the Technical Department prior to order placement.

### Limiting Chemical Composition

Ni+Co .....	Remainder	Cu.....	0.50 max.
C .....	0.05 max.	Cr.....	28.0-31.5
Mn.....	5.0 max.	Ti.....	0.50 max.
Fe .....	7.0-12.0	Al .....	0.50 max.
S .....	0.015 max.	P .....	0.03 max.
Si .....	0.75 max.	Nb+Ta .....	1.0-2.5
Mo .....	0.50 max.	Others .....	0.50 max.

### Minimum Mechanical Properties

Tensile Strength, psi	80,000
MPa	552
Elongation, (4d) %	30

**Available Product Forms** - Supplied in 10lbs (4.54kg) hermetically sealed containers

Diameter	mm in	2.4 3/32	3.2 1/8	4.0 5/32	4.8 3/16
Length	mm in	229 9	356 14	356 14	356 14
Current (DC+)	A	45-65	75-100	95-130	125-165

INCONEL® Welding Electrode 152